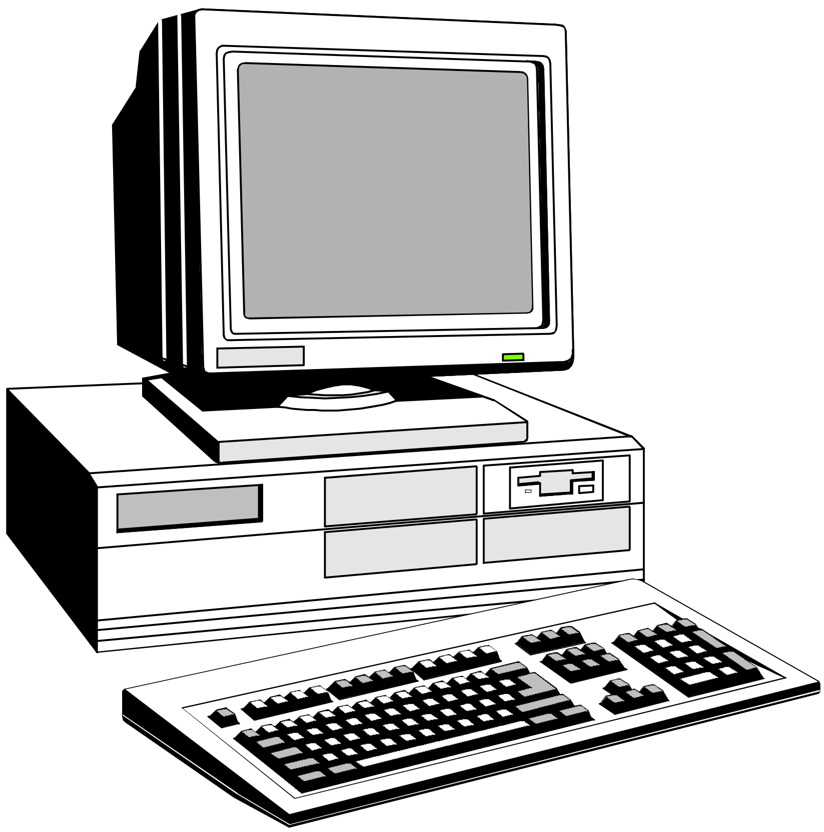
# Working Safely with Video Display Terminals



OFFICE SAFETY/vdt.cdr/1-95

U.S. Department of Labor
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# INTRODUCTION

The applications of computer technology and the accompanying use of VDTs are revolutionizing the workplaces of America, and their use will continue to grow in the future.

For example, according to some reports, there were only 675,000 VDTs in use in U.S. offices in 1976, in 1986, there were an estimated 28 million. The number of VDTs in use is growing rapidly, and in the 1990's, there may be anywhere from 40 to 80 million VDTs in the workplace [1, 2].

Along with this expanding use of VDTs have come reports about adverse health effects for VDT operators. In an effort to inform employers and employees, this discussion briefly examines the potential hazards and interventions employers can use to prevent or reduce the potential harmful effects of working with VDTs.

## VDT Components

VDTs, comprised of a display screen, a keyboard, and a central processing unit, have rapidly replaced the use of typewriters and other office machines.

The display screen is the output device that shows what the computer is processing. Display screens can be monochrome (green, white, or orange on a black background), or color.

The keyboard is the input device that allows the user to send information to the "brains" of the computer. Keyboards are commonly used for data entry and inquiry. The keyboard is similar to a standard typewriter keyboard but with additional special keys and functions.

The central processing unit is referred to as the "brains" of the computer. It is the center of operation for all the computer processing and performs calculations and organizes the flow of information into and out of the system.

The VDT operates at high voltages, but the power supplies generating these voltages produce very little current. All data processing equipment, including VDTs, must meet stringent international safety standards in this regard.

## HEALTH EFFECTS

In the wake of the expanding use of VDTs, concerns have been expressed about their potential health effects. Complaints include excessive fatigue, eye strain and irritation, blurred vision, headaches, stress, and neck, back, arm, and muscle pain. Other concerns include general physical discomfort, cumulative trauma disorders, and potential exposure to electromagnetic fields. Research has shown that these symptoms can result from problems with the equipment, work stations, office environment or job design, or from a combination of these. Some of the most common stressors, their related health effects, and their means of prevention are discussed briefly in the following sections.

### Eyestrain

Visual problems such as eyestrain and irritation are among the most frequently reported complaints by VDT operators. These visual symptoms can result from improper lighting, glare from the screen, poor positioning of the screen itself, or copy material that is difficult to read. These problems usually can be corrected by adjusting the physical and environmental setting where the VDT users work. For example, work stations and lighting can and should be arranged to avoid direct and reflected glare anywhere in the field of sight, from the display screen, or surrounding surfaces.

VDT operators also can reduce eyestrain by taking vision breaks, which may include exercises to relax eye muscles after each hour or so of operating a VDT[1]. Changing focus is another way to give eye muscles a chance to relax. The employee needs only to glance across the room or out the window from time to time and look at an object at least 20 feet away. Other eye exercises may include rolling or blinking the eyes, or closing them tightly for a few seconds.

### Fatigue and Musculoskeletal Problems

Work performed at VDTs may require sitting still for considerable time and usually involves small frequent movements of the eyes, head, arms, and fingers. Retaining a fixed posture over long periods of time requires a significant static holding force, which causes fatigue.

Proper work station design is very important in eliminating these types of problems. Some variables of work station design include the VDT table, chair, and document holder. An individual work station should provide the operator with a comfortable sitting position sufficiently flexible to reach, use, and observe the display screen, keyboard, and document.

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[1] The National Institute for Occupational Safety and Health (NIOSH) recommends a 15-minute rest break after 2 hours of continuous VDT work for operators under moderate visual demands; and a 15-minute rest break after 1 hour of continuous VDT work where there is a high visual demand or repetitive work tasks.

Some general considerations to minimize fatigue include posture support (back, arms, legs, and feet), and adjustable display screens and keyboards. VDT tables or desks should be vertically adjustable to allow for operator adjustment of the screen and keyboard. Proper chair height and support to the lower region of the back are critical factors in reducing fatigue and related musculoskeletal complaints. Document holders also allow the operator to position and view material without straining the eyes, or neck, shoulder, and back muscles.

The type of task performed at the VDT may also influence the development of fatigue. In designing a work station, the type of tasks involved should be considered when determining the placement of the display screen and keyboard.

VDT operators also are subject to a potential risk of developing various musculoskeletal and nerve disorders such as cumulative trauma, or repetitive motion, disorders. Carpal tunnel syndrome (CTS) is one commonly recognized cumulative trauma disorder among VDT operators. CTS is caused by repetitive wrist-hand movement and exertion. CTS is the compression and entrapment of the median nerve where it passes through the wrist into the hand--in the carpal tunnel.

When irritated, the tendons and their sheaths housed inside the narrow carpal tunnel swell and press against the nearby median nerve. The pressure causes tingling, numbness, or severe pain in the wrist and hand.

CTS usually can be reduced by stopping or limiting the activity that aggravates the tendons and median nerve (e.g., data/keyboard entry), by maintaining proper posture, or as a last resort, by having surgery. For correct posture, VDT operators should sit in an upright position at the keyboard, with arms parallel to the floor. The wrists and forearms also may require support, depending on the tasks involved.

## Radiation

Another issue of concern for the VDT operator is whether the emission of radiation, such as X-ray or electromagnetic fields in the radio-frequency and extreme low frequency ranges, poses a health risk. Some workers, including pregnant women, are concerned that their health could be affected by electromagnetic fields emitted from VDTs. The threat from X-ray exposures is largely discounted because of the very low emission levels. The radiofrequency and extreme low frequency electromagnetic fields are still at issue despite the low emission levels. To date, however, there is no conclusive evidence that the low levels of radiation emitted from VDTs pose a health risk to VDT operators. Some workplace designs, however, have incorporated changes--such as increasing the distance between the operator and the terminal and between work stations--to reduce potential exposures to electromagnetic fields.

Since the possible effects of radiation from VDTs continue to concern operators, the issue is still being researched and studied. OSHA has asked the Committee on Interagency Radiation

Research and Policy Coordination to nominate a panel to read and evaluate all the literature on the subject and to determine whether there is sufficient data upon which to establish a dose-response relationship or develop an assessment of the significance of risk for workers exposed to electromagnetic fields at wave lengths relevant to VDTs. NIOSH has a resource booklet entitled, "NIOSH Publications on Video Display Terminals" and continues to study the question of VDT operator risk from exposure to electromagnetic fields.

## INTERVENTIONS

There are a variety of interventions that employers can implement to reduce or prevent harmful effects associated with VDT use.

### Lighting

Light should be directed so that it does not shine into the operator's eyes when the operator is looking at the screen. Further, lighting should be adequate for the operator to see the text and the screen but not so bright as to cause glare or discomfort.

There are four basic lighting factors that must be controlled to provide suitable office illumination and avoid eyestrain: quantity, contrast, and direct and reflected glare.

***Quantity.*** In most offices, light fixtures and daylight provide illumination for work surfaces (e.g., 50-100 foot-candles). High illumination "washes out" images on the display screen; therefore, if possible, where VDTs are used, illumination levels should be somewhat lower (i.e., 28-50 foot-candles are often satisfactory).

***Contrast.*** Contrast is the difference in luminance or brightness between two areas. To prevent the visual load caused by alternate light and dark areas, the difference in illuminance between the VDT display screen, horizontal work surface, and surrounding areas should be minimized.

Most of the tasks associated with VDTs do not require precise visual acuity, and diffuse (indirect) lighting is appropriate. The advantages of diffuse lighting are twofold: there tend to be fewer hot spots, or glare sources, in the visual field; and the contrasts created by the shape of objects tend to be "softer." The result, in terms of luminous intensities, is a more uniform visual field. Where indirect lighting is not used, parabolic louvers on overhead lights are probably the next best way to ensure that light is diffused.

***Glare.*** Glare is usually defined as a harsh, uncomfortably bright, light. Glare is dependent upon the intensity, size, angle of incidence, luminance, and proximity of the source to the line of sight. Glare may be the result of direct light sources in the visual field (e.g., windows), or reflected light from polished surfaces (e.g., keyboards,) or from more diffuse reflections which may reduce contrast (e.g, improper task lighting). Glare may cause annoyance, discomfort, or loss in visual performance and visibility.

In many cases, the reorientation of work stations may be all that is necessary to move sources of glare out of the line of sight. The proper "treatment" for window glare includes baffles, venetian blinds, draperies, shades, or filters. The face of the display screen should be at right angles to windows and light sources. Care should be taken, particularly when terminals are installed within 20 feet of windows, to ensure that there is some method of blocking the sun's light, such as blinds or curtains.

To limit reflection from walls and work surfaces visible around the screen, these areas should be painted a medium color and have a nonreflective finish. Work stations and lighting should be arranged to avoid reflected glare on the display screen or surrounding surfaces.

Anti-glare filters that attach directly to the surface of a VDT screen can help reduce glare. Two types of filters are available: natural density filters, which scatter and diffuse some of the light reflected off the glass display screen, and micromesh filters, which not only scatter the light but also absorb most of the light reflected from the surface of the screen by means of an imbedded interwoven grid of dyed nylon fibers.

Newer model keyboards tend to have anti-glare matte finishes. Further, lighting should be adequate to enable the operator to see the text and the screen, but not so bright as to cause glare. Where used, work station lighting should be easily adjustable and directed at source documents and not at the display screen surface.

## Work Station Compatibility and Design

In the office environment, the work station consists primarily of a work surface of some type, a chair, VDT equipment, and other related items.

The employee must have adequate work space to perform each of the tasks required by the job. Individual body size must be considered and will influence the design of the chair, the height of the work surface, and access to various elements of the work station, including the display screen.

A height-adjustable work surface is an advantage. In general, a good VDT work surface will provide as many adjustable features as possible. Also, adequate legroom should be provided for the employee to stretch out and relieve some of the static load that results from sitting with the legs in a fixed position for long periods.

***Chairs.*** The chair can be a crucial factor in preventing adverse health effects as well as in improving employee performance in office work. As the majority of office workers spend most of their time sitting, proper back and shoulder support helps to reduce fatigue. If the chair does not fit the worker properly, there can be serious physical effects, as well as effects on performance. Consequently, the appropriate types of ergonomic chairs should be made available to accommodate various worker needs.

***Chair Height.*** When an employee must spend from 6 to 8 hours in the chair, the height of the chair and the work surface are critical. The human body dimension that provides a starting point for determining correct chair height is the "popliteal" height. This is height from the floor to the point at the crease behind the knee. The chair height is correct when the entire sole of the foot can rest on the floor or footrest and the back of the knee is slightly higher than the seat of the chair. This allows the blood to circulate freely in the legs and feet.

***Seatpan Design.*** Size and shape are two factors to consider in the design of the seatpan of the chair. The seatpan can be slightly concave with a rounded, or "waterfall," edge. This will help distribute the weight and may also prevent sliding forward in the chair. The angle of the seatpan should also be considered. Some options include a seatpan that slopes slightly down at the back or one that has a forward tilt that produces less stress on the lower region.

***Backrest.*** A proper backrest should support the entire back including the lower region. The seat and backrest of the chair should support a comfortable posture that permits frequent variations in the sitting position. The backrest angle and chair height should be easily adjustable. A foot rest may be necessary for shorter individuals.

## VDT Design

***Display Screen.*** Most new VDTs have separate, adjustable keyboards and display screens that allow both the keyboard and display screen to be positioned appropriately for the employee. This is important because VDT operators may spend a considerable amount of time looking at the display. The height of the display screen surface must be determined in relation to the task and the operator's height.

In addition, screens that swivel horizontally and tilt or elevate vertically enable the operator to select the optimum viewing angle.

The topmost line of the display should not be higher than the user's eyes. The screen and document holder should be the same distance from the eye (to avoid constant changes in focus) and close enough together so the operator can look from one to the other without excessive movement of the neck or back. The incline of the document holder should be adjustable.

The preferred viewing distance for VDTs ranges between 18 and 24 inches. To this distance must be added the depth of the display itself. Some displays are as much as 20 inches deep. The best way to deal with this, other than increasing table depth, is to install a keyboard extension on the front of the desk.

Legibility is also a primary consideration in selecting a display screen. Legibility factors to be considered include symbol size and design, contrast, and sharpness.

***Keyboard.*** The keyboard should be detachable and adjustable to ensure proper position, angle, and comfort for the operator. A lower than normal work surface may be required to keep the operator's arms in a comfortable position. The thickness and the slope of the keyboard are critical in determining the preferred height. The keyboard and table, therefore, have to be selected in relation to each other, or the surface must be adjustable. Options for keyboard placement also should be considered in choosing the size and adjustability of the work surface.

The preferred working position for most keyboard operators is with the forearms parallel to the floor and elbows at the sides, which allows the hands to move easily over the keyboard. The wrist should be in line with the forearm. A padded and detachable wrist rest for the keyboard can help keep the operator's wrists and hands in a straight position while key stroking.

Operating a VDT, like any form of sustained physical or mental work, will lead eventually to fatigue. It may take the form of visual fatigue, muscular fatigue, general body fatigue, or mental and psychological fatigue. Rest pauses to alleviate or delay the onset of fatigue may be necessary. The frequency and duration should be determined by the employer and should depend on the task involved, the pattern of work, and the individual VDT operator concerned.

## REFERENCES

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